BRIEFER ARTICLES.

PHYSICAL PROPERTIES OF BOG WATER.

CONTRIBUTIONS FROM THE HULL BOTANICAL LABORATORY. LVII.

THAT many plants growing typically in the peat bogs of the northern United States and Canada exhibit the same structural characters as do those occurring in very dry soils of the same region has long been known by students of plant distribution. But the question why these so-called xerophytic swamps differ so entirely in the nature of their vegetation from the drained or river swamps near by has never received a decisive answer. The idea is generally current among workers in this field that the factor determining the nature of the vegetation in bog areas lies, somehow, in the nature of the soil. Schimper states clearly that only xerophytes thrive in peat bogs, "because of the humous acids in the soil."[1] In another place (*l. c.*, p. 4) he says that a soil may be "physiologically dry" for various reasons, among which are (1) "abundance of soluble salts" and (2) "richness of the soil in humous acids." In still another place (*l. c.*, p. 657) the same writer describes the sphagnum bog ("high moor") as having a soil solution which "contains humates of alkalis in solution besides the humous acids," in which character these bogs differ from the "meadow moors," or grassy marshes.

It becomes evident immediately that if the "physiological dryness" of the bog be due to humous acids or humous salts, these substances may check absorption of water by plants either physically—by high osmotic pressure—or chemically—by toxic or stimulation effects. The question as to whether or not bog waters have a concentration appreciably higher than those of river and lake swamps near by should be easy of answer. Therefore, in 1901, the writer began a series of determinations of the osmotic pressure of the bog waters which were available. By the well-known Beckmann apparatus, determinations of the lowering of the freezing point were made, and from the data thus obtained the approximate osmotic pressure of the solution at 25° C. was calculated.[2]

[1] SCHIMPER, A. F. W., Plant geography upon a physiological basis. Translated by W. R. Fisher. Oxford. 1903. P. 8.

[2] For methods of procedure see LIVINGSTON, B. E., The rôle of diffusion and osmotic pressure in plants, part I, chap. VI. Chicago. 1903.

Bog water has now been studied from a number of widely distant localities, namely: from Aetna and Millers, Ind. (at the southern end of Lake Michigan); from Oconomowoc, Wis.; from Grand Rapids, Mich.; from Ann Arbor, Mich.; from Toms River, N. J.; and from near Port Jervis, N. J. The results obtained are tabulated below, together with a brief characterization of the flora of the bogs. Data for $\frac{1}{100}$ sea water are given for comparison. In the table, lowering of the freezing point, due to dissolved substances, is given in degrees centigrade. The osmotic pressure is given in millimeters of a mercury column and also in terms of M, which represents the pressure developed in a molecular solution of any non-electrolyte.

TABLE OF PHYSICAL PROPERTIES OF NATURAL WATERS.

Source of Water	Nature of Vegetation	Lowering of Freezing Point (degrees C.)	Calculated Osmotic Pressure	
			Mm. of Hg	M
Drained swamps of Hackensack River, N. J.	.....	0.005	50.075	$\frac{29}{10000}$
New York city supply (Croton and Bronx Rivers)	.....	0.005	50.075	$\frac{29}{10000}$
Chicago city supply (Lake Michigan)	.....	0.01	100.15	$\frac{58}{10000}$
Grand River, Grand Rapids, Mich.	.....	0.01	100.15	$\frac{58}{10000}$
Aetna, Ind.	Rhus Vernix, Drosera.	0.01	100.15	$\frac{58}{10000}$
Millers, Ind.	Larix, Rhus Vernix.	0.005	50.075	$\frac{29}{10000}$
Oconomowoc, Wis.[3]	Typical Larix swamp.	0.02	200.30	$\frac{117}{10000}$
Grand Rapids, Mich.	Larix, Sphagnum, Eriophorum, Oxycoccus.	0.015	150.225	$\frac{187}{10000}$
Ann Arbor, Mich.:				
First Lake Bog[4]	Larix, Chamaedaphne, Sphagnum, Aronia.	0.005	50.075	$\frac{29}{10000}$
West Lake Bog[5]	Sphagnum, Chamaedaphne, Potentilla palustris, Salix.	0.0125	125.188	$\frac{73}{10000}$
Toms River, N. J.	Chamaecyparis, Sphagnum, Chamaedaphne, Sarracenia. Oxycoccus.	Average of 13 tests, 0.0057	57.086	$\frac{33}{10000}$
		Max., 0.017	170.26	$\frac{99}{10000}$
		Min., 0.0025	25.038	$\frac{15}{10000}$
Port Jervis, N. J.[6]	Aronia, Chamaedaphne.	0.006	60.090	$\frac{35}{10000}$
$\frac{1}{100}$ sea water	.....	0.0225	250.075	$\frac{146}{10000}$

[3] This water was obtained for me by Dr. H. C. Cowles.

[4] This lake and its bog are described in detail by WELD, L. H., Botanical survey of the Huron River Valley. II. A peat bog and morainal lake. BOT. GAZ. 37: 36–52. 1904.

[5] This lake and bog are described by REED, H. S., A botanical survey of the Huron River Valley. I. The ecology of a glacial lake. BOT. GAZ. 34: 125–139. 1902. These Ann Arbor waters were obtained by the kindness of Mr. E. N. Transeau.

[6] This water was obtained through the kindness of Dr. C. C. Curtis, of Columbia University.

The tests here recorded were made in the summer, autumn, and winter, several bogs being studied both in the dryest part of the former season and in the middle part of the latter. These last-named tests showed practically no difference in osmotic pressure corresponding to

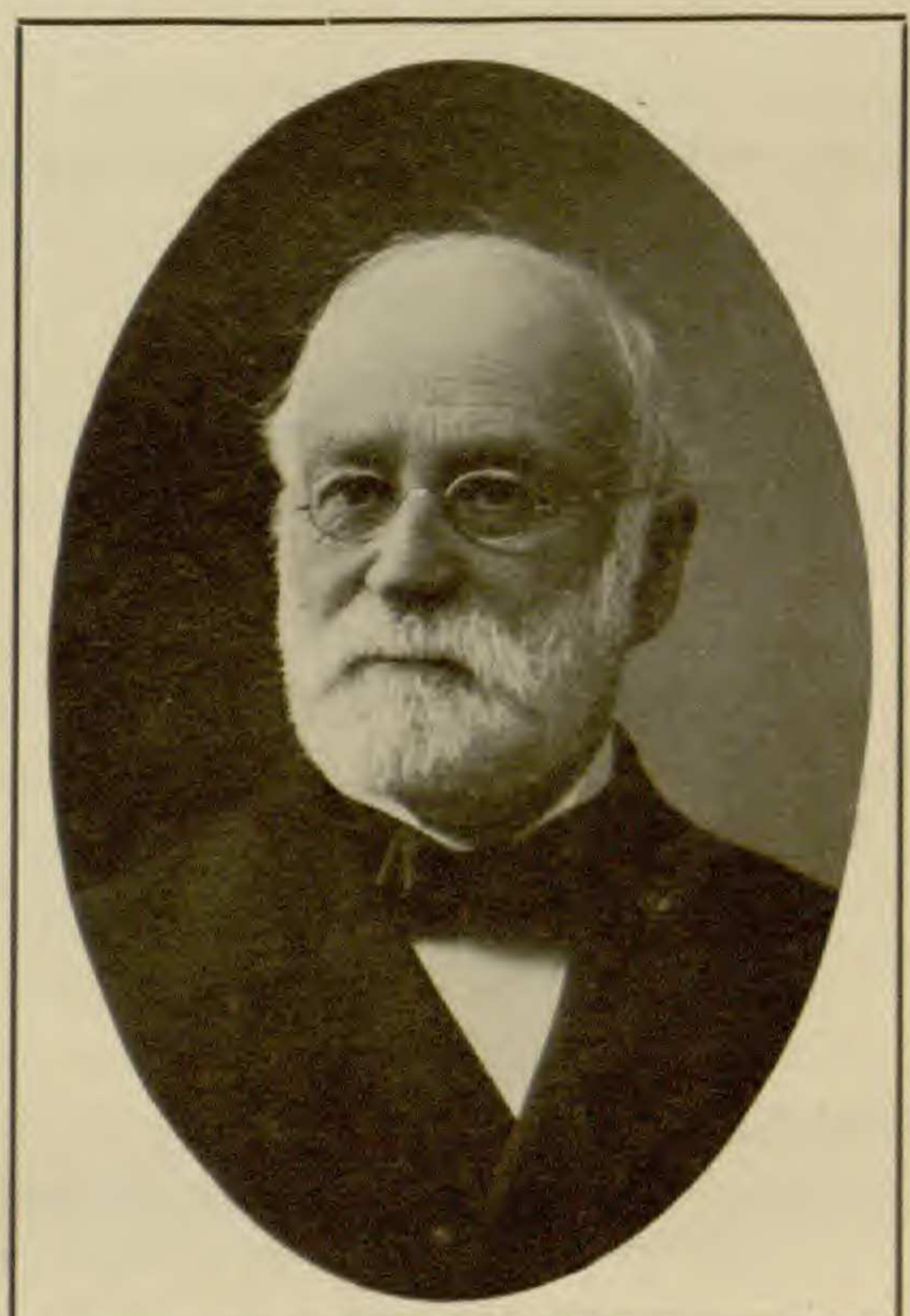
the season. Keeping the bottled water for months and even years does not alter its osmotic pressure appreciably.

The conclusion to be drawn from the material just presented is simply that *bog waters do not have an appreciably higher concentration of dissolved substances than do the streams and lakes of the same region.* Thus we are driven to the idea that if there is any property of bog water which prevents ordinary swamp plants from growing therein, this property must rest upon the chemical nature of the very small amounts of dissolved substances present. The nature and physiological properties of these bodies the writer is now studying.—BURTON EDWARD LIVINGSTON, *Hull Botanical Laboratory, The University of Chicago.*

WILLIAM M. CANBY.

(WITH PORTRAIT)

THE announcement of the death of Mr. William M. Canby, of Wilmington, Delaware, will come as a personal loss to botanists throughout the country, for he has been as well the intimate friend of many of them as a most generous contributor to all our public and private herbaria. Although Mr. Canby had not been in the best of health for some time, his condition was not such as to cause any serious alarm to his friends. On February 23 he went south for rest and change, but he contracted a severe cold, which was followed by a chill, and died very suddenly March 10, at North Augusta, South Carolina.



William Marriott Canby was born in Philadelphia, Pennsylvania, March 17, 1831, thus being nearly 73 years of age at the time of his death. He received his early education at the Friends School at Westtown, near West Chester, Pennsylvania, and from private tutors.